

New Hampshire Volunteer Lake Assessment Program

2002 Interim Report for Warren Lake Alstead



NHDES
Water Division
Watershed Management Bureau
6 Hazen Drive
Concord, NH 03301



OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **WARREN LAKE** the program coordinators recommend the following actions.

We would like to congratulate the association on expanding its sampling program to include three sampling events this season! In addition, we would like to thank you for conducting a shoreline lake survey! We understand that the number of sampling events and types of sampling you decide to conduct per summer will depend upon volunteer availability, and your associations' water monitoring goals and funding availability. Since weather patterns and activity in the watershed can change throughout the summer, and from year to year, and even from hour to hour during a rain event, it is a good idea to sample the lake at least once per month over the course of the season. **Keep up the good work!**

We would like to remind the association that the **Lake Sunapee Region Lab is open at Colby Sawyer College in New London**. This lab was established to serve the large number of lakes in the greater Lake Sunapee area. It may be closer for your association to pick up equipment and drop off samples in New London than in Concord. This lab is inspected by DES and operates under a DES approved quality assurance plan. We encourage the lake association to utilize this lab next summer. To find out more about the lab, and to schedule dates to pick up bottles and equipment, please call Bonnie Lewis, the lab manager, at (603) 526-3486.

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a and are naturally found in lake

ecosystems, the chlorophyll-a concentration found in the water gives an estimation of the concentration of algae or lake productivity. **The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 ug/L.**

Similar to the summer of 2001, the summer of 2002 was filled with many warm and sunny days and there was a lower than normal amount of rainfall during the latter-half of the summer. The combination of these factors resulted in relatively warm surface waters throughout the state. The lack of fresh water to the lakes/ponds reduced the rate of flushing which may have resulted in water stagnation. Due to these conditions, many lakes and ponds experienced increased algae growth, including filamentous green algae (the billowy clouds of green algae typically seen floating near shore), and some lakes/ponds experienced nuisance cyanobacteria (blue-green algae) blooms.

The historical data (the bottom graph) show that the 2002 chlorophyll-a mean is **less than** the state mean. Overall, visual inspection of the historical data trend line (the bottom graph) shows **a variable** in-lake chlorophyll-a trend, meaning that the concentration has **fluctuated** since monitoring began in 1991. (Please note that the lake was not sampled from 1993-1998.)

After the lake/pond has been sampled for at least 10 consecutive years, we will conduct a statistical analysis of the data. This will allow us to objectively determine if there has been a significant change in the annual mean chlorophyll-a concentration since monitoring began.

While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Therefore, algal concentrations may increase when there is an increase in nonpoint sources of nutrient loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). It is important to continually educate residents about how activities within the watershed can affect phosphorus loading and lake quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a

person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

Two different weather related patterns occurred this past spring and summer that influenced lake quality during the summer season.

In late May and early June of 2002, numerous rainstorms occurred. Stormwater runoff associated with these rainstorms may have increased phosphorus loading, and the amount of soil particles washed into waterbodies throughout the state. Some lakes and ponds experienced lower than typical transparency readings during late May and early June.

However, similar to the 2001 sampling season, the lower than average amount of rainfall and the warmer temperatures during the latter-half of the summer resulted in a few lakes/ponds reporting their best-ever Secchi-disk readings in July and August (a time when we often observe reduced clarity due to increased algal growth)!

The historical data (the bottom graph) show that the 2002 mean transparency is ***slightly less than*** the state mean.

Overall, visual inspection of the historical data trend line (the bottom graph) shows ***a slightly decreasing*** trend for in-lake transparency, meaning that the transparency has ***slightly worsened*** since monitoring began.

As discussed previously, after the lake/pond has been sampled for 10 consecutive years, we will conduct a statistical analysis of the data to objectively determine lake quality trends.

Typically, high intensity rainfall causes erosion of sediments into the lake/pond and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants are available from NHDES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum,

and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The historical data for the epilimnion (the upper graph) and the hypolimnion (the lower graph) show that the 2002 total phosphorus mean is **less than** the state median.

Overall, visual inspection of the historical data trend line for the epilimnion (the upper graph) shows **a stable** total phosphorus trend, which is **less than** the state median, since monitoring began.

Visual inspection of the historical data trend line for the hypolimnion (the lower graph) shows **a slightly decreasing** total phosphorus trend, which means that the concentration has **slightly improved** since monitoring began. We hope this trend continues! (However, it is important to keep in mind that this trend is based on a limited data set since the hypolimnion has only been sampled in 1991 and 2002.)

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands. If you would like to educate watershed residents about how they can help to reduce phosphorus loading into the lake/pond, please contact the VLAP Coordinator.

TABLE INTERPRETATION

➤ Table 2: Phytoplankton

Phytoplankton populations undergo a natural succession during the growing season (Please refer to page 12 of the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds. An overabundance of cyanobacteria (previously referred to as blue-green algae) indicates that there may be an excessive total phosphorus concentration in the lake/pond, or that the ecology is out of balance. Some species of cyanobacteria can be toxic to livestock,

pets, wildlife, and humans. (Please refer to pages 12 - 14 of the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding cyanobacteria).

➤ **Table 4: pH**

Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire’s lakes and ponds is 6.5, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to page 16 of the “Chemical Monitoring Parameters” section of this report.

The mean pH at the deep spot this season ranged from **6.38** in the hypolimnion to **6.36** in the epilimnion, which means that the water is **slightly acidic**.

Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake/pond pH.

➤ **Table 5: Acid Neutralizing Capacity**

Table 5 in Appendix B presents the current year and historic epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. For a more detailed explanation, please refer to page 16 of the “Chemical Monitoring Parameters” section of this report.

The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) continues to remain **low** (3.73 mg/L as CaCO₃) and is **less than** the state mean of 6.7 mg/L (Table 5). Specifically, this means that the lake/pond is **“moderately vulnerable”** to acidic inputs (such as acid precipitation) and has a **lower** ability than many lakes and ponds in the state to buffer against acidic inputs.

➤ **Table 6: Conductivity**

Table 6 in Appendix B presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical

expression of the ability of water to carry an electric current. For a more detailed explanation, please refer to page 16 of the “Chemical Monitoring Parameters” section of this report.

The conductivity has **gradually increased** in the lake/pond monitoring began (Table 6). Typically, sources of increased conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake/pond), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity. It is possible that the lower than normal amount rainfall during the latter-half of the summer reduced tributary and lake flushing, which allowed pollutants and ions to build up and resulted in elevated conductivity levels.

On July 24th this season, the Association conducted a shoreline conductivity survey using a hand held field conductivity meter. Specifically, the volunteer monitors drove a boat around the perimeter of the lake with the conductivity meter probe submersed approximately 1 foot into the water and the conductivity levels were recorded on a map periodically. Particular attention was paid to the conductivity levels near shoreline residential development. The objective of this survey was to better pinpoint areas of elevated conductivity around the lake (such as potentially failing septic systems, excessive fertilizer use, disturbed soils, etc.).

The results of the survey showed that, overall, the mean conductivity along the shoreline of the lake was approximately 67.5 uMhos/cm. There were not any particular areas of elevated conductivity near shoreline residential development where the volunteer monitors were concerned about the potential for failing septic systems.

During the shoreline conductivity survey, the conductivity in the inlets was also measured which revealed high levels at **Spruce Point** (166 uMhos/cm) and the **Dam Brook** (159 uMhos/cm). In addition, routine VLAP sampling this season (and in previous seasons) has revealed high conductivity levels in the **Spruce River Inlet** and **Carmen Cove Brook**. We recommend that your monitoring group conduct stream surveys and stormwater sampling along these inlets so that we can determine what may be causing the increases. For a detailed explanation on how to conduct a stream survey and stormwater sampling, please refer to this year’s “Special Topic Article” which is included in Appendix D of this report.

➤ **Table 8: Total Phosphorus**

Table 8 in Appendix B presents the current year and historic total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to page 17 of the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The total phosphorus concentration in the **Smith Hill Brook** sample was elevated (**19 ug/L**) on the **July** sampling event. The turbidity of the sample was also elevated (**6.6 NTUs**), which suggests that the stream bottom may have been disturbed while sampling (Table 11). When the stream bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting samples in the inlets, please be sure to sample where there the stream is flowing and where the stream is deep enough to collect a "clean" sample.

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 in Appendix B shows the dissolved oxygen/temperature profile(s) for the 2002 sampling season. Table 10 shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The dissolved oxygen concentration was again **high** at all depths sampled at the deep spot of the lake/pond. Typically, shallow lakes and ponds that are not deep enough to stratify into more than one or two layers will have relatively high amounts of oxygen at all depths. This is due to continual lake mixing and diffusion of oxygen into the bottom waters induced by wind and wave action.

The dissolved oxygen concentration was **greater than 100%** saturation at **0.1, 1.0, and 2.0** meters at the deep spot on the **June 26th** sampling event. Layers of algae can raise the dissolved oxygen in the water column, since oxygen is a by-product of photosynthesis. Wave action from wind can also dissolve atmospheric oxygen into the upper layers of the water column.

➤ **Table 11: Turbidity**

Table 11 in Appendix B lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to page 19 of the "Other Monitoring Parameters" section of this report for a more detailed explanation.

➤ **Table 12: Bacteria (*E.coli*)**

Table 12 lists the current year data for bacteria (*E.coli*) testing. *E. coli* is a normal bacterium found in the large intestines in humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured, and its presence in the water, in defined amounts, indicates that sewage **MAY** be present. If sewage is present in the water, potentially harmful pathogens may also be present.

The *E.coli* concentration was **low** at the Boat Landing, Edith's Beach, and Spruce River sampling sites this season.

The *E.coli* concentration was **elevated** at Spencer Beach on the June 26th sampling event (196 counts per 100 mL of sample). Specifically, the concentration **exceeded** the state standard of 88 counts per 100 mL designated for public bathing places. However, the concentration **did not exceed** the state standard of 406 counts per 100 mL designated for Class B waters. On the July and September sampling events, the *E.coli* concentration at this beach returned to low levels (14 counts per 100 mL or less).

If you are concerned about *E. coli* levels at this beach, you may want to conduct *E.coli* testing on a weekend during heavy beach use or after a storm event. Since bacteria die quickly in cool pond waters, testing is most accurate and most representative of the health risk to bathers when the source (humans, animals, or waterfowl) is present. For a detailed explanation on how to conduct stormwater sampling, please refer to this year's special topic which is found in Appendix D of this report.

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit:

During the annual visit to your lake/pond, the biologist conducted a "Sampling Procedures Assessment Audit" for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor's Field Manual). This assessment is used to identify any aspects of sample collection in which volunteer monitors are not following the proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an **excellent** job collecting samples on the annual biologist visit this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the biologist to provide additional training. Keep up the good work!

Sample Receipt Checklist:

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did an **excellent** job when collecting samples and submitting them to the laboratory this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the laboratory staff to contact your group with questions, and no samples were rejected for analysis.

NOTES

- **Monitor's Note (07/29/02):** Blue Herron and King Fisher observed while sampling. Dam Brook was dry or not flowing. A lot of pickerel weed observe in Carmen Cove.
- **Monitor's Note (8/30/02):** We have noticed drought conditions all summer. There was a big rain storm on 8/30. Pickerel Cove was pretty dry. Spruce Point had good flow. Got all inlet samples except Dam Brook (dry!).

USEFUL RESOURCES

Changes to the Comprehensive Shoreland Protection Act: 2001 Legislative Session, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/sp/sp-8.htm

Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/wmb/wmb-10.htm

The Lake Pocket Book. Prepared by The Terrene Institute, 2000. (internet: www.terrene.org, phone 800-726-4853)

Managing Lakes and Reservoirs, Third Edition, 2001. Prepared by the North American Lake Management Society (NALMS) and the Terrene Institute in cooperation with the U.S. Environmental Protection Agency. Copies are available from NALMS (internet: www.nalms.org, phone 608-233-2836), and the Terrene Institute (internet: www.terrene.org, phone 800-726-4853)

Organizing Lake Users: A Practical Guide. Written by Gretchen Flock, Judith Taggart, and Harvey Olem. Copies are available from the Terrene Institute (internet: www.terrene.org, phone 800-726-4853)

Proper Lawn Care in the Protected Shoreland: The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-2.htm

Sand Dumping - Beach Construction, WD-BB-15, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-15.htm

Swimmers Itch, WD-BB-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-2.htm

Use of Lakes or Streams for Domestic Water Supply, WD-WSEB-1-11, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/ws/ws-1-11.htm

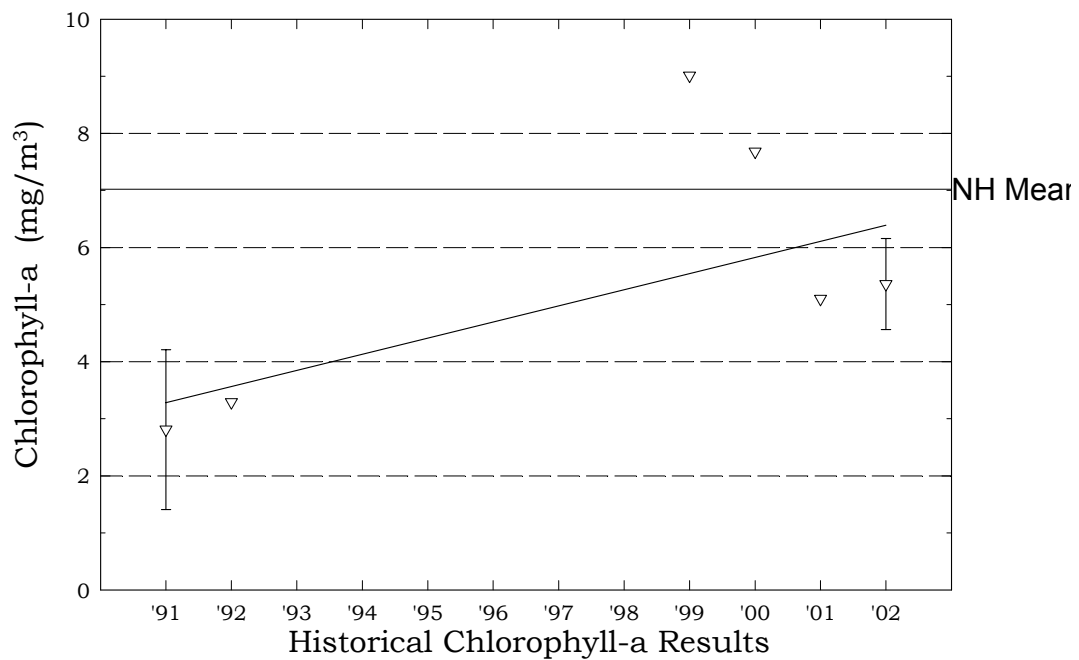
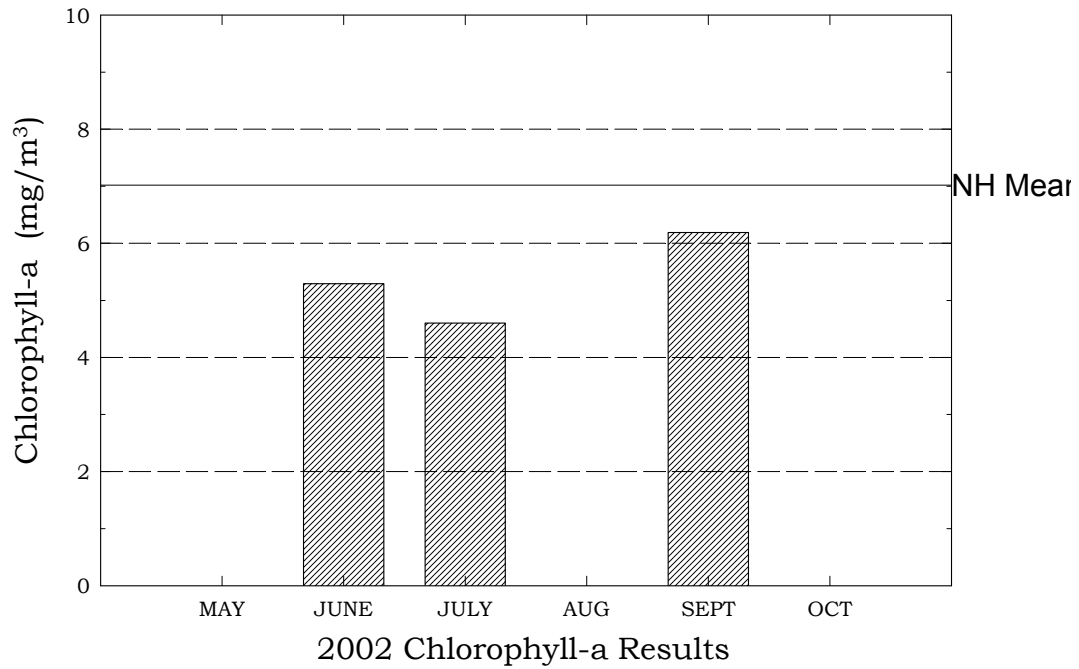
Water Milfoil, WD-BB-1, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-1.htm

Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-4.htm

Appendix A: Graphs

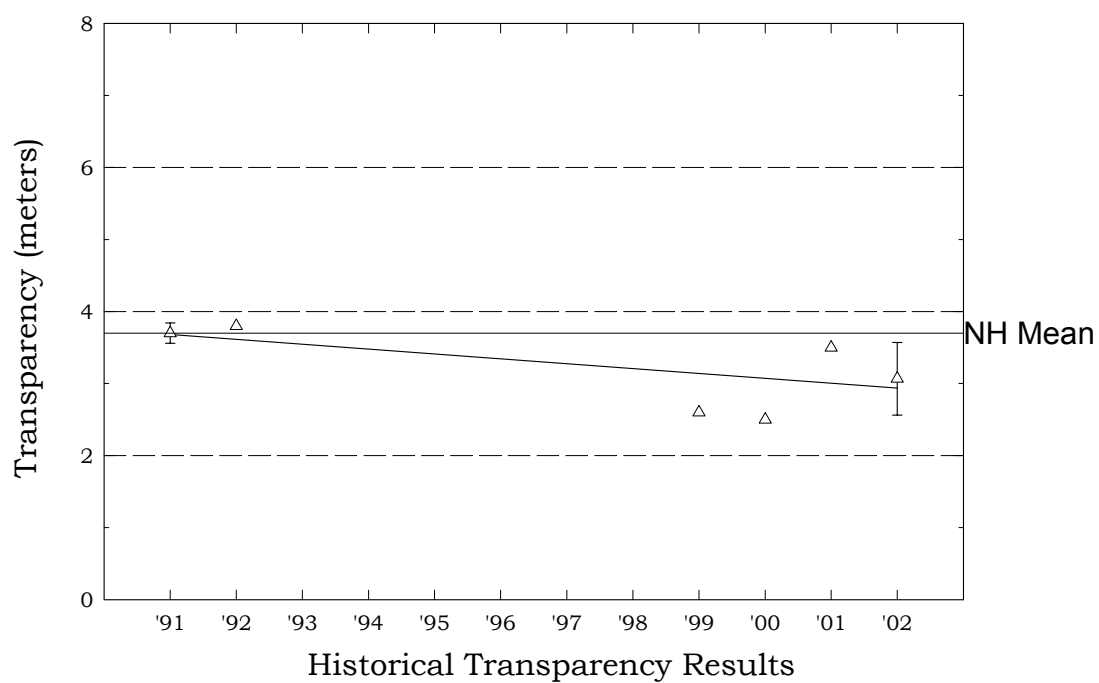
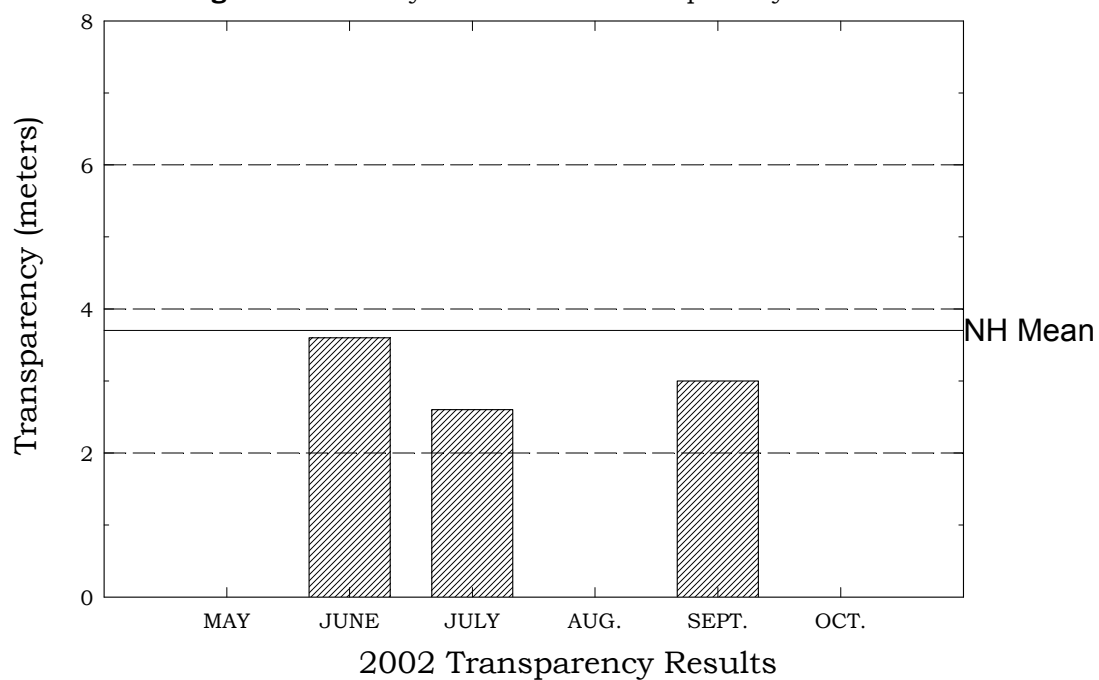
Warren Lake, Alstead

Figure 1. Monthly and Historical Chlorophyll-a Results



Warren Lake, Alstead

Figure 2. Monthly and Historical Transparency Results



Warren Lake, Alstead

Figure 3. Monthly and Historical Total Phosphorus Data.

